

PATENT

Attorney Docket No. A-71184/DJB/VEJ  
Application No. 09/980,956**REMARKS**

Reconsideration of this Application is respectfully requested. Upon entry of the foregoing amendments, claims 2-13, 15-20, 22-23, 25-29 are pending in the application, with claims 25 and 29 being the independent claims. New claims 26-29 have been added. Support for the subject matter of the new and amended claims is contained in the application as originally filed. Because the foregoing changes introduce no new matter, their entry is respectfully requested.

Based on the above Amendments and the following Remarks, Applicant respectfully requests that the Examiner reconsider all outstanding objections and rejections and that they be withdrawn.

***Examiner's Claim Suggestions***

The Examiner suggested that claims 3, 4, and 23 could be improved by deleting the "preferably" clauses. These clauses, as well as similar clauses in claims 5 and 15, have been removed from the claims by the above amendments, consistent with the Examiner's suggestion.

***Section 102(b) Rejections*****A. DE 19523637 (Claims 1, 6, 7, and 14)**

The Examiner has suggested that claims 1, 6, 7, and 14 were anticipated by DE 19523637 ("DE '637"). Specifically, the Examiner argues that DE '637 discloses a separator plate for a fuel cell comprising: (1) a steel substrate, (2) a diffusion barrier comprising a layer of copper, and (3) a corrosion protection layer. However, a review of DE '637 shows that it does not contemplate using copper as an intermediate diffusion barrier layer, but only as an exposed corrosion protection layer.

The disclosure of DE '637 is directed to a separator plate for molten carbonate fuel cells, which operate at a maximum temperature of 700 °C (page 3 of DE '637 translation). The

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disclosure on page 1 of the translation recognizes that high grade stainless steel, including aluminum-bearing steel, cannot be used on the anode-side of the separator plate because of the aggressive anode-side atmosphere that is present in molten carbonate fuel cells and because of the very high electrical resistance of the coatings that result on the anode side. The disclosure further recognizes on page 1 of the translation that this problem is resolved by providing a layer of nickel on the anode side of a high grade steel separator plate. The problem that the invention of DE '637 seeks to resolve is the very substantial amounts of nickel that are required for this purpose, by providing an improved anti-corrosive coating on the anode side (page 3 of translation). The problem is resolved by providing a thin diffusion barrier layer between the high grade steel substrate and a thinner layer of the usual anticorrosive coating material, nickel.

The preferred diffusion barrier layer is TiN, but it is clear from page 5 of the translation that alternatives are CrN, ZrN, TiCN and TiNi (see lines 5 and 6 from the bottom of the page). It is also clear from the same portion of page 5 of the translation that the nickel of the corrosion protection layer can be replaced by Cu, Pt, Ru or Pd. Thus, if copper is used in the molten carbonate fuel cell separator plate of DE '637, it is in the outermost corrosion protection layer.

There is no suggestion of the separator plate in DE '637 being used in a solid oxide fuel cell stack, as required by amended claims 25 and 29 of the application. More importantly, there is no proposal in DE '637 of a protective layer over any copper or copper-based layer to prevent Cu vapor escaping from the anode side of the gas separator at the operating temperature of the molten carbonate fuel cell system. Indeed, the protective layer materials proposed in the application, heat resistant steel and/or alumina, could not be used on the anode side of the gas separator of DE '637 because it would result in exactly the problem discussed above that the nickel layer on the high grade steel substrate seeks to resolve.

Claims 1 and 14 have been cancelled, and claims 6 and 7 have been amended to depend from claim 25. In light of the foregoing comments, it should be clear that claim 25, and accordingly claims 6 and 7, are not anticipated by DE '637. Accordingly, the rejection of claims 1, 6, 7, and 14 based on DE '637 should be withdrawn.

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Application No. 09/980,956**B. Badwal, U.S. Patent No. 5,942,349 (Claims 1, 5, 6, and 25)**

The Examiner argues in Section 4 of the Office Action that examined claims 1, 5, 6 and 25 are anticipated by the applicants own Badwal, U.S. Patent No. 5,942,349 ("Badwal"), on the basis of the described separator plate comprising a chromium-containing substrate, a chromia protection layer thereon, and a metal oxide layer on the surface of the chromia. As noted at column 4 lines 40 to 46, the chromia protection layer may comprise copper.

In contrast to the present invention, Badwal is not concerned with the anode side of the gas separator plate (identified in the specification as an interconnect). Instead, it is entirely concerned with preventing the escape of Cr from the cathode side of the gas separator plate. It does this by providing an oxidation-resistant oxide surface layer on the cathode side of the separator plate substrate, the oxide surface layer comprising at least one metal M selected from the group Mn, Fe, Co and Ni, and an M, Cr spinel layer intermediate to the substrate and the oxide surface layer. This spinel layer is the layer that the Examiner has identified as the chromia layer. Column 4 lines 40 to 46 actually suggest that the M, Cr chromia protection layer may be doped with Cu or other elements to improve the properties such as the electrical conductivity of the protection layer. The Examiner suggests that this doping makes the layer equivalent to the layer of copper recited in claim 1, which clearly is not correct.

A primary purpose of the present invention is to use the high thermal conductivity of copper, and thereby reduce the thickness of the gas separator plates in a solid oxide fuel cell stack as compared to stainless steel and other gas separator plates. This advantage is not available in the gas separator plate of Badwal, where the primary separator substrate material is a Cr-containing alloy or cermet, as described at column 4 lines 27 to 40. In the claims, the copper-containing layer is defined as "a layer of copper or of copper-based alloy containing at least 50 wt% Cu". From this is clear that "a layer of copper" is just that, 100% copper. If a copper-based alloy is used it must contain at least 50 wt% Cu. There is nothing like this in Badwal.

Accordingly, the rejection of claims 5, 6, and 25 based on Badwal should be withdrawn.

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Application No. 09/980,956**C. JP 60-154470 (Claims 1, 6, and 14)**

The Examiner has rejected claims 1, 6, and 14 as being anticipated by JP 60-154470 ("JP '470"). The Office Action included an Abstract and a Derwent citation of JP '470. The Abstract did not mention copper, but the Derwent citation appeared to list copper as a possible separator material. A certified translation of JP '470 is attached hereto as Exhibit A. Contrary to the Derwent citation of JP '470, a review of the actual complete translation of JP '470 shows that JP '470 does not contemplate the use of copper at all. Since the present invention is focused on the use of copper in a solid oxide fuel cell gas separator plate for its high thermal conductivity, JP '470 cannot be considered to anticipate the claims.

The gas separator plates proposed in JP '470 are for a phosphoric acid fuel cell (Ex. A, page 3, third paragraph) and are proposed to replace the sheets of mixed and integrated graphite and thermosetting resin and/or thin sheets of sintered carbon that have been employed as separators in such fuel cells in the past (Ex. A, page 3, paragraph 5). The proposed TiC coating on sheets of steel, stainless steel or aluminum proposed for use in place of the graphite/carbon gas separators is to prevent corrosion of the metal by the phosphoric acid electrolyte and to prevent oxide films being formed on the cathode side of the metal (Ex. A, page 4, second paragraph). Neither the graphite/carbon separator plates, nor the proposed TiC coated separator plates, would be suitable for use in the high temperature environment of a solid oxide fuel cell stack. More fundamentally, neither use copper separator plates.

Accordingly, the rejection of claims 1, 6, and 14 based on JP '470 should be withdrawn.

**D. Shinoda, U.S. Patent No. 4,873,149 (Claims 1, 2, 4, 6, 11-14, 17-19 and 21-24)**

The Examiner has rejected claims 1, 2, 4, 6, 11 to 14, 17 to 19 and 21 to 24 as anticipated by Shinoda, U.S. 4,873,149. This disclosure is directed to vibration-damping metal sheets comprising two metal plates joined together by pressing the plates together with minute inclusions between them. Proposals for materials for the metal plates (column 4 lines 23 to 40)

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include carbon steel, stainless steel, NiCoMo steel, other steels, non-ferrous metals such as aluminum, copper, titanium and nickel, and plated and clad metal plates. The Examples describe low carbon steel plates, stainless steel plates, and aluminum alloy plates including aluminum bronze.

As the minute inclusions, "use may be made of any material which can bite into the metal plates ... to join them together" (column 4 lines 41 to 43). Preference is given to metals which are easily diffusible into the metal plates by heat treatments such as diffusion annealing (column 4 lines 53 to 55), "with the preferred ... metal represented by Cu and Ni etc."

The vibration-damping metal sheets of Shinoda are proposed for use as foundation metals for gears in diamond cutters or chip saws such as high speed rotators or as structural materials etc. needing to have vibration-damping properties such as working structures in automobiles (column 1 lines 10 to 15). The remaining independent claims (25 and 29) both recite "at least two planar solid oxide fuel cells." There is no suggestion of the vibration-damping metal sheets being used in any type of fuel cell, let alone a solid oxide fuel cell, and the disclosure is clearly not relevant to the invention as now claimed.

Furthermore, no person skilled in the art of fuel cells would look to a vibration-damping metal sheet for use as a separator plate. There are no moving parts in a fuel cell stack. Most importantly, one of the functions of a separator plate may be to provide an electrical flow path for the electrical current generated by the fuel cells, and the electrical resistance that would build up at the junction of the metal plates of the vibration-damping metal sheet of Shinoda, would make the vibration-damping metal sheet entirely unsuitable for use in a solid oxide fuel cell.

Accordingly, the rejection of claims 1, 2, 4, 6, 11 to 14, 17 to 19 and 21 to 24 should be withdrawn.

***Section 103(b) Rejections***

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Application No. 09/980,956**A. JP '470 (Claims 2 and 5)**

The Examiner has rejected claims 2 to 5 as obvious over JP '470. The argument clearly fails for the reasons argued above, that JP '470 has no proposal for using copper in a fuel cell gas separator. Because this limitation of independent claim 25 is absent from JP '470, as seen in the attached Exhibit A certified translation of JP '470, the rejection of claims 2 and 5 based on JP '470 should be withdrawn.

**B. DE '637 in View of WO 99/13522 (Claims 8, 9, 10, 15, and 16)**

Finally, the Examiner has rejected claims 8, 9, 10, 15 and 16 as obvious over DE '637 in view of the applicant's WO 99/13522 (WO '522).

As discussed above, DE '637 discloses a molten carbonate fuel cell gas separator comprising a high-grade steel substrate and on the anode side, a diffusion barrier layer formed of TiN, CrN, ZrN, TiNi Or TiCn (or chromoxid) and an outer corrosion protection layer of Ni, Cu, Pt, Ru or Pd. Alternatively, the diffusion barrier layer may replace the outer corrosion protection layer entirely. The high grade steel substrate is therefore on the cathode side of the gas separator.

WO '522 is concerned solely with the cathode side of a heat resisting metal alloy gas separator plate in a solid oxide fuel cell assembly. The alloy material of the gas separator plate may be, for example, a heat resisting steel or a nickel alloy such as Haynes 230. A protective layer of alumina is formed on the cathode side of the heat resisting metal alloy, and a layer of silver is provided between the alumina and the cathode layer of the adjacent fuel cell. The silver may be formed on the gas separator plate or be separate to it.

Thus, even accepting that it would be obvious to a skilled person to modify the high grade steel substrate of the molten carbonate fuel cell gas separator of DE '637 by the solid oxide fuel cell gas separator member of WO '522, the principal change would be a layer of alumina on

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the cathode side of the high grade steel gas separator and a layer of silver between the layer of alumina and the cathode layer of the fuel cell. There would be no change to the anode side of the gas separator, leaving any one of Ni, Cu, Pt, Ru or Pd as the outermost corrosion protection layer, or even the TiN, etc. diffusion barrier layer as the outermost layer.

Accordingly, the proposed combination fails to show all the limitation of the underlying base claim (25), and the rejection of claims 8, 9, 10, 15 and 16 based on DE '637 in view of WO '522 should be withdrawn.

***Request for Refund***

Applicant filed a Supplemental Information Disclosure Statement on June 10, 2005 ("Supplemental IDS") disclosing references cited by the European Patent Office in a Communication Dated April 13, 2005. Because these references were cited within three months of when the Supplemental IDS was filed, no fee should have been due. The Supplemental IDS included the statement required by Rule 97(e)(1). Accordingly, it is respectfully requested that the fee of \$180 charged to the deposit account of the Applicant's attorney should be refunded to the same deposit account, namely Deposit Account No. 50-2319 (Matter No. 461124-20; Docket No. A-71184/DJB/VEJ).

***CONCLUSION***

All of the stated grounds of objection and rejection have been properly traversed, accommodated, or rendered moot. Applicant therefore respectfully requests that the Examiner reconsider all presently outstanding objections and rejections and that they be withdrawn. Applicant believes that a full and complete reply has been made to the outstanding Office Action and, as such, the present application is in condition for allowance. If the Examiner believes, for any reason, that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at the number provided below.

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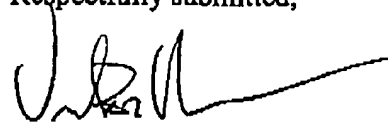
The Commissioner is hereby authorized to charge any underpayment of fees associated with this communication, including any necessary fees for extension of time or additional claims, and/or credit any overpayment to Deposit Account No. 50-2319 (Order No. 463678-00208; Docket No. A-71981/RBC/VEJ).

Respectfully submitted,

Date:

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